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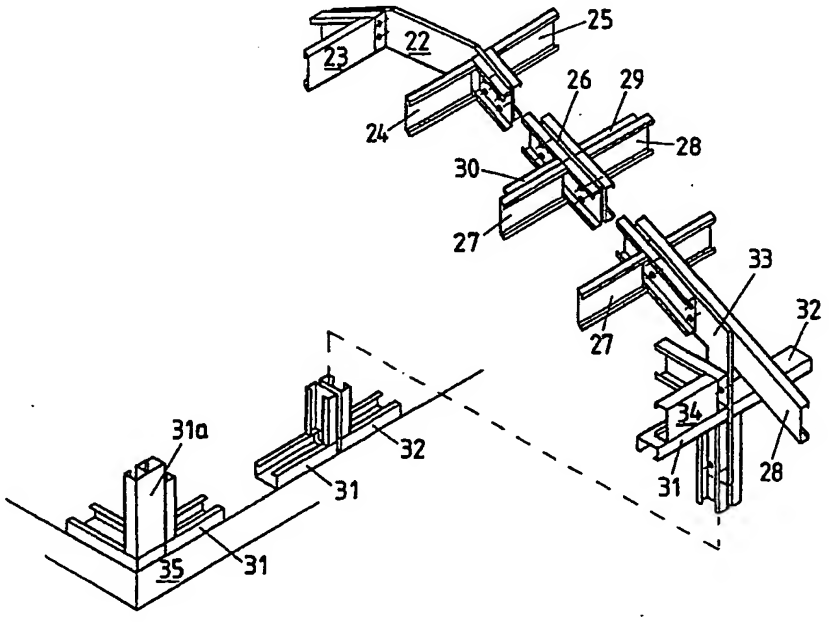

(57) Abstract

A modular building framework comprising structural sub-frames and interconnecting plates. The sub-frames have an open construction and are made in standard size to reduce the number of components required to construct a building. The interconnecting plates are of three designs: an eaves plate (22); a ridge plate (33), and a wall plate (21). The modular building framework can be easily extended to two or more storeys. The same framework can form walls, floors, ceilings and roof.

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TITLE

"MODULAR BUILDING FRAMEWORK"

FIELD OF THE INVENTION

This invention relates to building structures and in particular to a modular building framework which can be rapidly erected with minimal effort and manpower. The invention will find application in a range of building situations including domestic housing, industrial sheds and farm structures.

BACKGROUND OF THE INVENTION

Various attempts have been made to develop modular building systems. The primary problem with prior art attempts has been shortcomings with the structural integrity of the resultant structure. Another difficulty is that the known systems are not truly modular since they are difficult to erect and very difficult to modify once erected.

The inventors are aware of United States Patent Number 4858398 in the name of Ricchini which describes a prefabricated, modular building construction system that addresses the problem of structural integrity by constructing panels of channel shaped frame members surrounding a rigid insulating core with protective surface layers laminated on both sides. This approach has two primary problems. Firstly, there is difficulty in providing a weatherproof seal between the panels. Secondly, the resultant structure requires internal trusses to support the roof structure. Both of these features are undesirable.

The inventors are also aware of United States Patent Number 5072554 in the name of Hayman that is directed to a prefabricated modular storage building constructed from a number of panels which are interlocked by means of a flange and channel arrangement. This invention suffers from similar problems to that described above as well as being particularly difficult to assemble.

Modular framing systems, such as those described by De Blanken in International Patent Application WO29537/94, aim to provide economies of handling, storage and transport by performing a number of

the construction tasks in a fabrication shop and then transporting the prefabricated modules to the construction site. Although achieving the stated aim, at least in part, they do not provide any particular advantage in terms of the ease of construction or cost of materials.

Another prior art system known to the inventors is that described in International Patent Application Number WO 95/02097 (PCT/AU94/00335) in the name of Leftminster Pty Ltd. The Leftminster system is based upon transportable prefabricated wall, floor and roof panels. In the Leftminster system the panels required for a particular structure are designed and constructed before transportation to the erection site. The prefabricated panels are erected on site onto prepared floor support footings. The Leftminster system is not modular since it is not based upon a standard set of panels. Furthermore, it requires a large number of separate components including bracing (or trusses) to support the roof.

Although the Leftminster application describes a prefabricated building system having some improvements over known metal frame constructions it fails to capture an advantage due to the complexity of construction on site and the extensive variety of components required. The need for a truss-like roof structure for structural integrity seriously limits the versatility and applicability of the system.

In general, the prior art construction techniques require a complex array of components including studs, plates, cleats, wall and roof girts, nuts and bolts, trusses, cladding, and so forth. The large number of components requires the builder to spend a considerable amount of time fitting them together. Furthermore, the known modular structures are normally limited to specific structural cladding which is essential for adding strength to the building. Also, once erected, the structures are difficult to extend.

OBJECT OF THE INVENTION

It is an object of the present invention to provide a modular

building framework which has minimal components and forms a structure which does not require the use of cladding or bracing to provide structural integrity.

It is a further object of the invention to provide a modular building framework which is simple and fast to assemble or disassemble compared to prior known systems.

It is a yet further object of the invention to provide a modular building framework which provides ease of structural modification.

Further objects will be evident from the following discussion.

DISCLOSURE OF THE INVENTION

In one form, although it need not be the only or indeed the broadest form, the invention resides in a modular building framework comprising structural sub-frames and interconnecting plates;

said structural sub-frames being of an open construction having a pre-determined configuration;

said structural sub-frames being removably connected to form the building framework including walls and roof;

wherein wall sub-frames are removably connected to form wall structures, roof sub-frames are removably connected to the wall sub-frames by first interconnecting plates and adjacent roof sub-frames meeting at a ridge are removably connected by second interconnecting plates to form a roof structure;

the connection of sub-frames to sub-frames and sub-frames to interconnecting plates being by removable fixing means; and

wherein structural integrity of the building framework is provided by the interconnected sub-frames without the need for cladding or bracing.

Structural sub-frames preferably comprise perimeter members and internal members. The perimeter members suitably perform a structural role and the internal members provide cladding support.

The roof structure is suitably provided by interconnected sub-frames without the need for trusses or bracing.

The modular building framework may further comprise a ceiling structure formed from interconnected sub-frames. Structural integrity of the building framework may be provided by the interconnected sub-frames forming the wall structures and ceiling structure. Preferably the roof structure is not required for structural integrity of the building framework when comprising a ceiling structure.

In preference the structural sub-frames are assembled from materials having high tensile strength such as metal sections, carbon fibre beams, synthetic timber, plastics or other modern construction material.

The sub-frames can be constructed to the appropriate wind code rating. Preferably the building framework has a wind code rating up to W70.

The structural sub-frames are suitably made in a number of standard sizes and configurations. The sub-frames are suitably pre-manufactured and held in stock with a supply of pre-manufactured interconnecting plates.

There is preferably provided a third interconnecting plate adapted to removably connect standard sub-frames to form combination sub-frames.

In preference the structural sub-frames are interconnected to form internal wall structures, ceiling structures and floor structures without additional structural components.

The resultant structure may suitably be clad in any desired material without regard to the structural properties of the cladding.

In preference the modular building framework is erected in situ on bolts cast in an edge thickened or pier fitted concrete foundation.

The second interconnecting plate preferably comprises a ridge plate with a roof pitch of between 15° and 50°.

In a further form the invention resides in a method of constructing a modular building including the steps of :

constructing a plurality of sub-frames, said sub-frames being

of an open construction and having a pre-determined configuration;

removably connecting adjacent wall sub-frames to form wall structures;

removably connecting roof sub-frames to said wall sub-frames with first interconnecting plates;

removably connecting adjacent roof sub-frames to form a roof structure; and

removably attaching cladding to the sub-frames to form a building.

In preference the step of removably connecting adjacent roof sub-frames to form a roof structure includes the step of removably connecting roof sub-frames meeting at a ridge with second interconnecting plates.

In preference the method further includes the steps of removably connecting further sub-frames to form internal wall structures, floor structures or ceiling structures.

The method may further include the step of removably connecting sub-frames to sub-frames with third interconnecting plates to form larger structures.

In a still further form the invention resides in a method of extending a modular building including the steps of:

detaching cladding from a modular building framework;

disconnecting one or more sub-frames from adjacent sub-frames and interconnecting plates;

connecting additional sub-frames to existing sub-frames to extend the modular building framework;

re-connecting disconnected sub-frames; and

attaching cladding to complete the extended modular building.

BRIEF DETAILS OF THE DRAWINGS

To assist in understanding the invention preferred embodiments will now be described with reference to the following figures

in which:

FIG 1 is a schematic of a standard wall sub-frame;

FIG 2 shows the method of forming a sub-frame;

FIG 3 is a schematic of a standard wall sub-frame including a door and a window space;

FIG 4 is a schematic of a standard roof sub-frame;

FIG 5 is an isometric view of a shed construction incorporating a variety of standard sub-frames;

FIG 6 is a schematic of an eaves plate;

FIG 7 is a schematic of a ridge plate;

FIG 8 is a schematic of an extension plate;

FIG 9 is a cut-away view of a portion of an assemblage of sub-frames;

FIG 10 shows the arrangement of a typical footing;

FIG 11 is a series of figures demonstrating the method of construction of a shed;

FIG 12 is an exploded view of a modular building framework for a house;

FIG 13 is an isometric view of an alternative shed construction;

FIG 14 is a schematic of a ridge plate for the shed of FIG. 13; and

FIG 15 tabulates constructional data.

DETAILED DESCRIPTION OF THE DRAWINGS

In the drawings, like reference numerals refer to like parts. For simplicity of explanation reference will be made to sub-frames constructed from steel channel members of 'C' profile. Adjacent members are welded to form the sub-frames. Although the preferred embodiment refers to steel channel members of specific dimensions, it will be apparent that other dimensions or other materials will be appropriate depending on the load-bearing capacity required. Welding may also be replaced by equivalent means, such as bolting or pressing, to assemble the sub-frames.

Referring to FIG 1, there is shown a typical wall sub-frame

comprising perimeter members constructed from 150 mm channel sections of 1.9 mm thickness, indicated as 1, and 1.0 mm thickness, indicated as 2. The sub-frames are formed with the channel sections having the 'C' facing inwards. Internal members 3 are 100 mm channel sections of 1.5 mm thickness. Channel sections are butt welded 4 as shown in FIG 2. The perimeter members 1, 2 perform a structural role by forming a portal-like frame and, when built on a concrete slab, piers or stumps, providing strong hold down. The internal members generally act as cladding supports in a similar manner to studs, girts, purlins, battens, heads, mullions and sills.

The wall sub-frames of FIG 1 are formed in a standard size of 3000 mm wide by 3000 mm high. To facilitate construction of a variety of structures, sub-frames are made in standard widths of 600 mm, 900 mm, 1500 mm, 2400 mm, 2700 mm, and 3000 mm and standard heights of 2400 mm, 2700 mm and 3000 mm. For special construction ½ size or ¼ size can be made.

The modular nature of the building framework allows a stock of sub-frames and interconnecting plates to be pre-manufactured to pre-determined configurations. The required sub-frames and interconnecting plates for a building are then supplied direct from stock as opposed to being purpose fabricated as in prior art systems. This arrangement also has advantages in achieving plumb and square in the modular building framework because it is constructed from pre-manufactured stock of pre-determined configuration with factory tolerances.

The inventors have found that only three basic types of sub-frames are required, these are :

a. C10015 sub-frames comprising perimeter members of 1.5 mm thick, 100 mm C section channels and internal members of 1.5 mm thick, 100 mm C section channels;

b. C15015 sub-frames comprising perimeter members of 1.5 mm thick, 150 mm C section channels and internal members of 1.5 mm thick, 150 mm C section channels; and

c. C15019P sub-frames comprising perimeter members of 1.9 mm thick, 150 mm C section channels and internal members of 1.5 mm thick, 150 mm C section channels.

A 3000 mm wide by 3000 mm high sub-frame with a door space and a window space is shown in FIG 3. As with the full wall sub-frame of FIG 1 the perimeter members 5 of the sub-frame are 150 mm channel sections of 1.5 mm thickness (or 1.9 mm for higher wind ratings) with the remaining members being of lighter gauge.

Roof sub-frames are formed in a similar manner to the wall sub-frames. The roof sub-frame depicted in FIG 4 are formed as 3000 mm by 3000 mm. The sub-frame is formed from 150 mm 'C' channel sections of 1.5 mm (or 1.9 mm) thickness.

A building 6 formed from a number of standard sub-frames is shown in FIG 5. The building is made from two identical sub-frames 7 designed with a garage door space. A door sub-frame 8 and window sub-frame 9 make up one side of the building. The remaining sides (not seen) are identical to the standard sub-frame of FIG 1. Four identical roof sub-frames 10 form the roof. Gable infill sub-frame 11 completes the modular building framework.

Wall sub-frames are removably connected to adjoining roof sub-frames by eaves plates 12, such as shown schematically in FIG 6. For the sub-frames described above, the eaves plates are made from 5 mm thick bisalloy with each arm 13 having a length of 700 mm. A locating lug 14 assists in locating the plate for assembly. A number of bolt holes, such as 15, are pre-drilled in the eaves plate to facilitate fixing.

Roof sub-frames meeting at a ridge are removably connected by ridge plate 16 shown in FIG 7. The ridge plate is also made from 5 mm thick bisalloy and has a number of bolt holes, such as 17. For the modular building framework shown in FIG 5 the ridge plate has 400 mm arms 18 and a 688 mm central region 19. The ridge plate is formed with a stiffening plate 20.

For larger structures an extension plate 21, as shown in FIG

8, facilitates connection of adjoining sub-frames to form a large roof or a tall building.

As assemblage of wall sub-frames, roof sub-frames, eaves plates, extension plates and roof plates are shown in FIG 9. A ridge plate 22 is shown connecting roof sub-frames 23 and 24 meeting at a ridge. Adjoining roof sub-frames, such as 25, will also be connected. In the example shown each side of the roof is two sub-frames long therefore requiring the use of an extension plate 26 to join the roof sub-frames 27, 28, 29 and 30. The roof sub-frames 28 and 27 extend beyond the wall sub-frames 31 and 32 to form eaves. The sub-frames 27, 28, 31 and 32 are connected with an eaves plate 33. (The roof sub-frame 27 is shown cut short to reveal the eaves plate 33.)

Although bisalloy interconnecting plates provide a high strength structure, they are not required in every situation. The interconnecting plates can be of mild steel if lower wind ratings are acceptable.

A ceiling framework 34 can be simply added to the modular building framework by bolting to, for example, the top of the wall sub-frame 31 and the eaves plate 33.

All roof sub-frames, wall sub-frames and interconnecting plates are bolted together with M12 8.8/S UNO bolts. The assemblage of FIG 9 can be easily disassembled by removing the bolts. Other fixing means such as self tapping screws and welds may be suitable in some situations.

The modular building framework is conveniently erected on a concrete slab 35 having M12 cast-in bolts 35a such as shown in FIG 10. Wall sub-frames 31 and 32 which meet at a corner are bolted to the concrete slab and to each other as shown in FIG 9.

A method of assembly of a modular building framework for a shed is depicted in FIG 11. A concrete slab is poured with cast-in bolts. The corner wall sub-frames are initially bolted together and to the concrete foundation as shown in FIG 11(a). The remaining wall sub-

frames are bolted to the concrete foundation as shown in FIG 11(b). Eaves plates may be conveniently bolted into position at this stage. A first roof sub-frame is erected into place and the highest point may be supported with props as shown in FIG 11© or with the gable infill (shown as 11 in FIG 5). The roof sub-frame is bolted to the eaves plates. A corresponding roof sub-frame is erected and bolted to the eaves plates. A ridge plate is bolted into position to connect the two roof sub-frames to form the stage shown in FIG 11(d). The remaining roof sub-frames are bolted into place to complete the modular building sub-frame.

The above describes one method of constructing a shed. For other structures the method of construction will vary. For example, a ceiling may be constructed on the assembled walls prior to the erection of the roof sub-frames. Furthermore, the roof could be assembled separately and lifted into position with a crane. The shed could be constructed directly onto the ground without a slab first being poured.

Due to the light weight of each sub-frame the steps depicted in FIG 11 to erect a modular building sub-frame can be performed by two people although the task is somewhat easier with three or more people.

The invention is not limited to the simple structures of FIG 5 and FIG 11. A residential building such as that shown in the exploded view of FIG 12 is possible. FIG 12 clearly shows a variety of different wall sub-frames, such as 36 and 37. Ceiling sub-frames 38 are also shown arranged to form a ceiling. There is no requirement for ceiling battens. Roof sub-frames 39 are shown arranged to form the roof of the house. There is no requirement for roof trusses or roof battening.

The inventors have found that the roof structure is not required for the structural integrity of the building framework. Ceiling sub-frames have sufficient structural capacity that a structure formed by the wall sub-frames and ceiling sub-frames meets relevant building standards. This provides flexibility in construction and facilitates multiple storey structures. Furthermore, the roof can be almost any shape without impacting on the strength or wind resistance of the rest of the structure.

It will be appreciated that any desired form of cladding 40 can be used to cover the modular building framework and complete the house. A common roof cladding would be Custom Orb 0.42 BMT. A common wall cladding would be timber, fibrous sheet or brick veneer.

It will be appreciated that the structure depicted in FIG 12 can be easily disassembled and extended or relocated. The ceiling framework has sufficient load bearing capacity to form the floor for another storey. To form the extra storey it is only necessary to unbolt and remove the eaves plates. Extension plates are bolted into place, the roof is raised or removed and additional wall sub-frames are bolted in place. The eaves plates are then bolted in place to connect the roof sub-frames to the new wall sub-frames.

Similarly, the structure can be extended laterally. A wall or section of wall is removed and additional wall sub-frames are assembled to enlarge the structure. Ceiling sub-frames and roof sub-frames are assembled as described above.

The invention has particular advantage to form structures of unconventional shape. The octagonal shed 41 of FIG 13 would normally be constructed with a central pillar. With the modular building framework described herein the shed can be constructed without a central pillar. A custom ridge plate 42, as shown in FIG 13, connects eight roof sub-frames 43. The roof sub-frames 43 are connected to the wall sub-frames in the same way as described above.

FIG 15 tabulates a variety of shed structures that can be constructed with the three basic sub-frames described earlier. The table shows the material combinations required to achieve required strengths (in kNm) and example shed sizes. Column 44 applies to C15019P/2 (two adjoining perimeter members) sub-frames and 5 mm Bisalloy 360 interconnecting plates. Column 45 applies to C15019P sub-frames and 5 mm Bisalloy 360 interconnecting plates. Column 46 applies to C15015 sub-frames and 5 mm Bisalloy 360 interconnecting plates. Column 47 applies to C15015 sub-frames and 5 mm mild steel interconnecting

plates.

For example, a shed 6 m wide by 3 m high constructed to W55C wind rating requires C15015 sub-frames and 5 mm Bisalloy 360 interconnecting plate (column 46) or better. Similar tabulations can be prepared for other structures, such as domestic housing. In general, C10015 sub-frames are used for the walls, C10015 or C15015 sub-frames are used for the ceilings and C15015 or C15019P sub-frames are used for the roof.

It will be evident to those skilled in the art of building construction that the modular building framework described herein offers a number of advantages. The rigid open framework structure enables a wide range of cladding materials to be used, which was not possible previously. The cladding can be erected onto the framework by conventional means.

Because a standard range of sub-frames are pre-manufactured there are significant advantages for improved measurement tolerances and increased quality assurance.

Structures with wind classification from the lowest rating of W28N (N1) through to the highest rating of W70C (C4) can be constructed using the same modular system.

Because of the minimal number of components and the light weight sub-frames, the layperson or professional builder can easily erect a building in minimal time. In practice it has been found that the modular system according to the present invention enables the frame erection time to be reduced by at least 50%. This minimises the impact of weather problems and reduces the time to lock-up and overall project completion.

Further, the height of the building can be increased at a later date by simply unbolting and removing the roof panels and eaves plates, affixing extra wall panels and interconnecting plates at the top of the existing wall panels, and replacing the eaves plates and roof panels.

The system is also applicable to the design and constructing of buildings having a variety of shapes, for instance hexagonal and

octagonal, and in these instances the roof framework panels will generally have a triangular or other configuration.

Throughout the specification the aim has been to describe the preferred embodiments of the invention without limiting the invention to any one embodiment or specific collection of features.

CLAIMS

1. A modular building framework comprising structural sub-frames and interconnecting plates;
said structural sub-frames being of an open construction having a pre-determined configuration;
said structural sub-frames being removably connected to form the building framework including walls and roof;
wherein wall sub-frames are removably connected to form wall structures, roof sub-frames are removably connected to the wall sub-frames by first interconnecting plates and adjacent roof sub-frames meeting at a ridge are removably connected by second interconnecting plates to form a roof structure;
the connection of sub-frames to sub-frames and sub-frames to interconnecting plates being by removable fixing means; and
wherein structural integrity of the building framework is provided by the interconnected sub-frames without the need for cladding or bracing.

2. The modular building framework of claim 1 wherein the structural sub-frames comprise perimeter members and internal members.

3. The modular building framework of claim 2 wherein the perimeter members provide structural integrity and the internal members provide cladding support.

4. The modular building framework of claim 1 wherein the roof structure is provided by interconnected sub-frames without trusses or bracing.

5. The modular building framework of claim 1 further comprising a ceiling structure formed from interconnected sub-frames.

6. The modular building framework of claim 5 wherein structural integrity of the building framework is provided by the interconnected sub-frames forming the wall structures and ceiling structure.

7. The modular building framework of claim 1 wherein the structural

sub-frames are assembled from materials having high tensile strength selected from the list including metal sections, carbon fibre beams, synthetic timber and plastic.

8. The modular building framework of claim 1 wherein the pre-determined configuration of the structural sub-frames comprise a number of standard sizes and configurations.

9. The modular building framework of claim 8 wherein the sub-frames and interconnecting plates are pre-manufactured.

10. The modular building framework of claim 1 the connection of wall sub-frames to roof sub-frames by first interconnecting plates permits the formation of eaves.

11. The modular building framework of claim 1 wherein the second interconnecting plate comprises a ridge plate with a roof pitch of between 15° and 50°.

12. The modular building framework of claim 1 further comprising a third interconnecting plate for removably connecting standard sub-frames to form combination sub-frames.

13. The modular building framework of claim 1 wherein structural sub-frames are interconnected to form internal wall structures, ceiling structures and floor structures without additional structural components.

14. The modular building framework of claim 1 further comprising a foundation upon which the sub-frames are erected.

15. The modular building framework of claim 14 wherein the foundation is a concrete foundation having cast-in bolts.

16. The modular building framework of claim 15 wherein the concrete foundation is edge thickened or pier fitted.

17. A method of constructing a modular building including the steps of:

constructing a plurality of sub-frames, said sub-frames being of an open construction and having a pre-determined configuration;

removably connecting adjacent wall sub-frames to form wall structures;

removably connecting roof sub-frames to said wall sub-frames with first interconnecting plates;

removably connecting adjacent roof sub-frames to form a roof structure; and

removably attaching cladding to the sub-frames to form a building.

18. The method of claim 17 wherein the step of removably connecting adjacent roof sub-frames to form a roof structure includes the step of removably connecting roof sub-frames meeting at a ridge with second interconnecting plates.

19. The method of claim 17 further including the steps of removably connecting further sub-frames to form internal wall structures, floor structures or ceiling structures.

20. The method of claim 17 further including the step of removably connecting sub-frames to sub-frames with third interconnecting plates to form larger structures.

21. A method of extending a modular building including the steps of:

detaching cladding from a modular building framework;

disconnecting one or more sub-frames from adjacent sub-frames and interconnecting plates;

connecting additional sub-frames to existing sub-frames to extend the modular building framework;

re-connecting disconnected sub-frames; and

attaching cladding to complete the extended modular building.

AMENDED CLAIMS

[received by the International Bureau on 20 August 1996 (20.08.96); original claims 1, 10, 11, 17 and 19-21 amended; new claims 22 and 23 added; remaining claims unchanged (4 pages)]

1. A modular building framework comprising structural sub-frames and interconnecting plates;

said structural sub-frames being of an open construction having a pre-determined configuration and being removably connected to form the building framework including walls and roof;

wherein wall sub-frames are removably connected to form wall structures, roof sub-frames are removably connected to the wall sub-frames by first interconnecting plates and adjacent roof sub-frames meeting at a ridge are removably connected by second interconnecting plates to form a roof structure;

the connection of sub-frames to sub-frames and sub-frames to interconnecting plates being by removable fixing means;

said modular building framework being constructible in multiple configurations; and

wherein structural integrity of the building framework is provided by the interconnecting sub-frames without the need for cladding or bracing.

2. The modular building framework of claim 1 wherein the structural sub-frames comprise perimeter members and internal members.

3. The modular building framework of claim 2 wherein the perimeter members provide structural integrity and the internal members provide cladding support.

4. The modular building framework of claim 1 wherein the roof structure is provided by interconnected sub-frames without trusses or bracing.

5. The modular building framework of claim 1 further comprising a ceiling structure formed from interconnected sub-frames.

6. The modular building framework of claim 5 wherein structural integrity of the building framework is provided by the interconnected sub-frames forming the wall structures and ceiling

structure.

7. The modular building framework of claim 1 wherein the structural sub-frames are assembled from materials having high tensile strength selected from the list including metal sections, carbon fibre beams, synthetic timber and plastic.

8. The modular building framework of claim 1 wherein the pre-determined configuration of the structural sub-frames comprise a number of standard sizes and configurations.

9. The modular building framework of claim 8 wherein the sub-frames and interconnecting plates are pre-manufactured.

10. The modular building framework of claim 1 wherein the connection of wall sub-frames to roof sub-frames by first interconnecting plates permits the formation of eaves.

11. The modular building framework of claim 1 further comprising third interconnecting plates for removably connecting one or more structural sub-frames having a pre-determined configuration to form combination sub-frames .

12. The modular building framework of claim 1 further comprising a third interconnecting plate for removably connecting standard sub-frames to form combination sub-frames.

13. The modular building framework of claim 1 wherein structural sub-frames are interconnected to form internal wall structures, ceiling structures and floor structures without additional structural components.

14. The modular building framework of claim 1 further comprising a foundation upon which the sub-frames are erected.

15. The modular building framework of claim 14 wherein the foundation is a concrete foundation having cast-in bolts.

16. The modular building framework of claim 15 wherein the concrete foundation is edge thickened or pier fitted.

17. A method of constructing a modular building having structural sub-

frames and interconnecting plates including the steps of:

pre-manufacturing a plurality of structural sub-frames including wall sub-frames and roof sub-frames, said sub-frames being of an open construction and having a pre-determined configuration;

removably connecting adjacent wall sub-frames with removable fixing means to form wall structures;

removably connecting roof sub-frames to said wall sub-frames with first interconnecting plates and removable fixing means;

removably connecting adjacent roof sub-frames with removable fixing means to form a roof structure, said roof structure not requiring truss members for structural integrity; and

removably attaching cladding to the roof structure and wall structures to form the modular building.

18. The method of claim 17 wherein the step of removably connecting adjacent roof sub-frames to form a roof structure includes the step of removably connecting roof sub-frames meeting at a ridge with second interconnecting plates.

19. The method of claim 17 further including the steps of removably connecting further wall sub-frames to the wall structures to form internal wall structures.

20. The method of claim 17 further including the steps of pre-manufacturing floor sub-frames and removably connecting the floor sub-frames to form an internal floor structure.

21. The method of claim 17 further including the steps of pre-manufacturing ceiling sub-frames and removably connecting the ceiling sub-frames to form a ceiling structure, said ceiling sub-frames being removably connected to wall sub-frames.

22. The method of claim 17 further including the step of removably connecting sub-frames to sub-frames with third interconnecting plates to form larger structures.

23. A method of changing the configuration of a modular building

having structural sub-frames and interconnecting plates including the steps of:

detaching cladding from a modular building framework of the modular building;

disconnecting one or more sub-frames from adjacent sub-frames and interconnecting plates by removing removable fixing means;

connecting additional sub-frames to existing sub-frames to extend or modify the modular building framework;

re-connecting disconnected sub-frames and interconnecting plates with removable fixing means; and

attaching cladding to complete the reconfigured modular building.

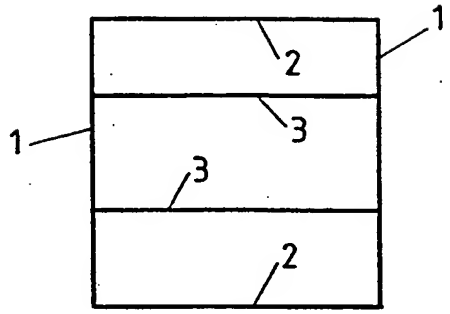


FIG. 1

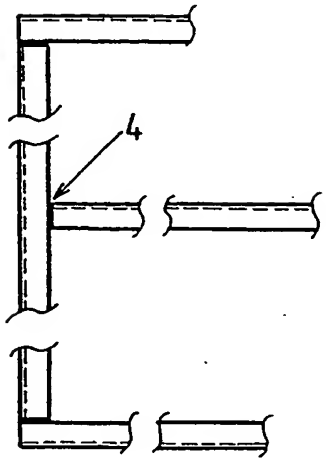


FIG. 2

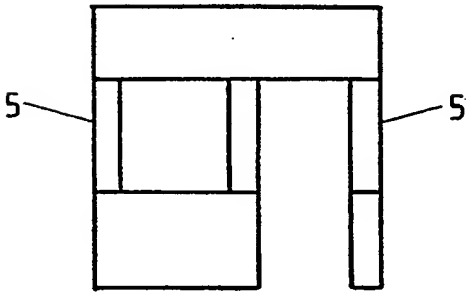


FIG. 3

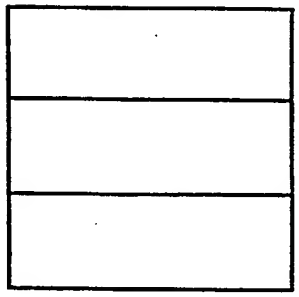


FIG. 4

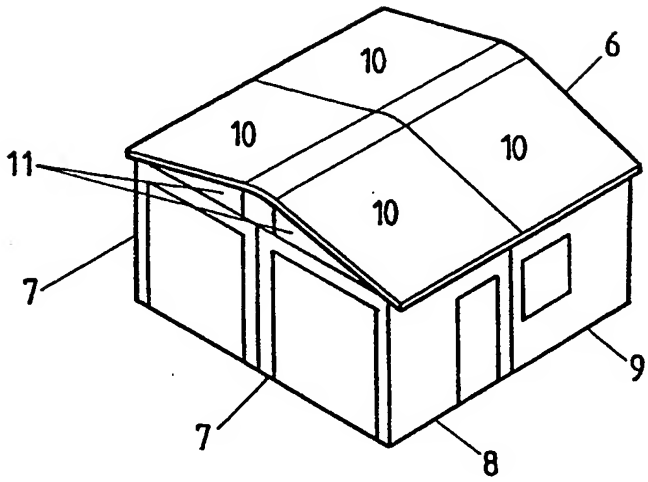


FIG. 5

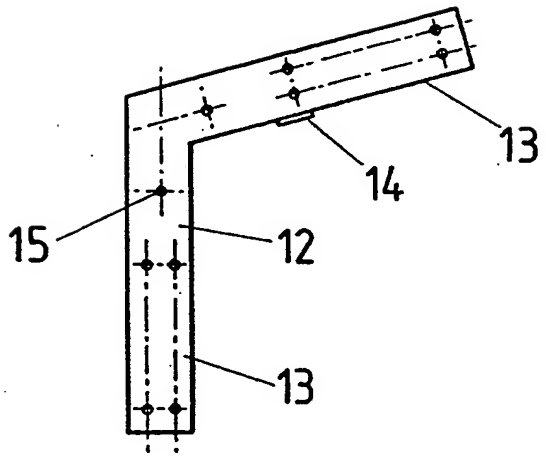


FIG. 6

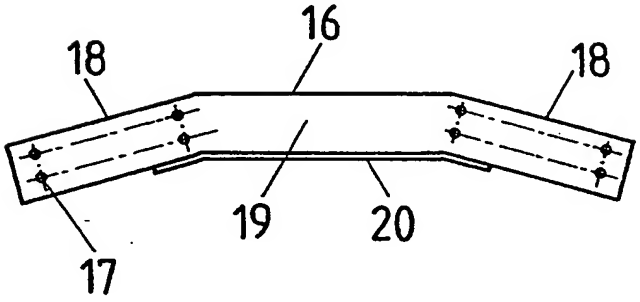


FIG. 7

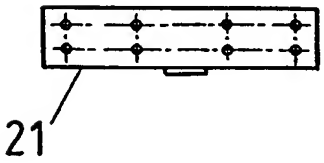


FIG. 8

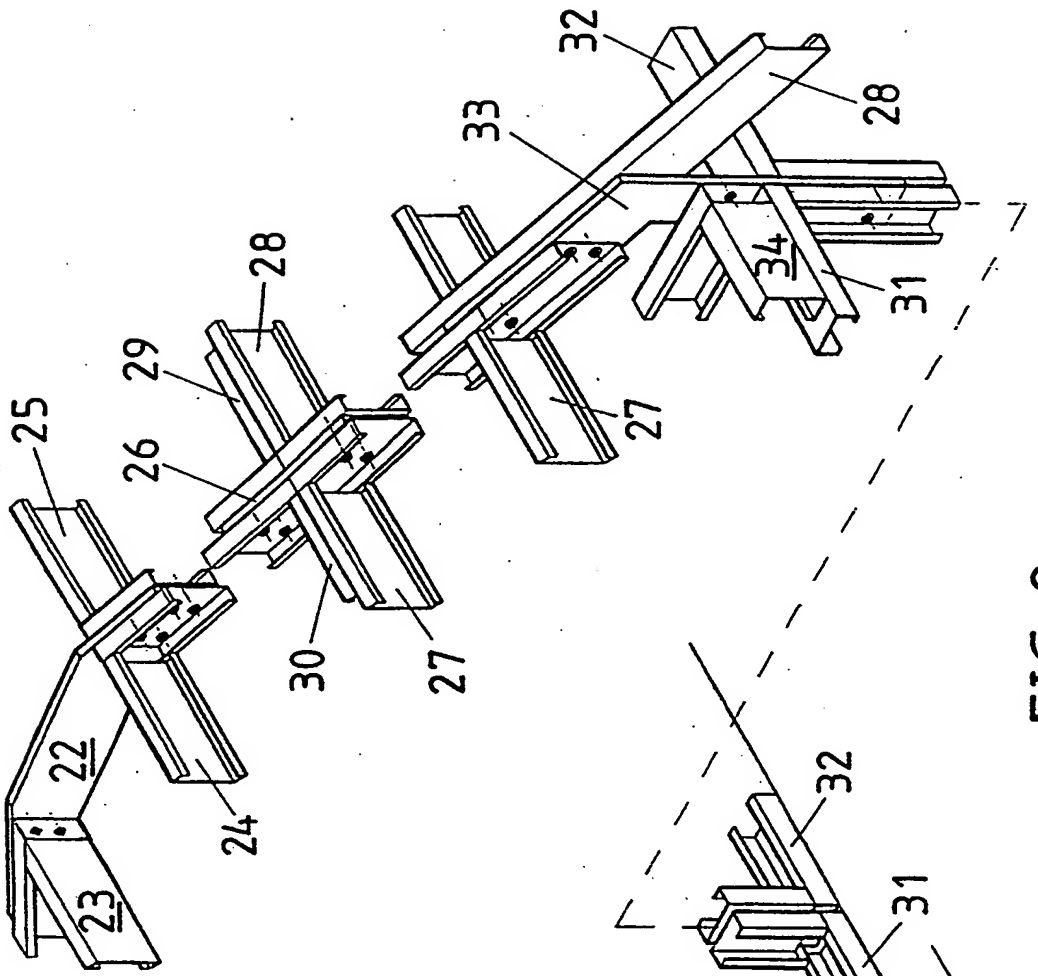
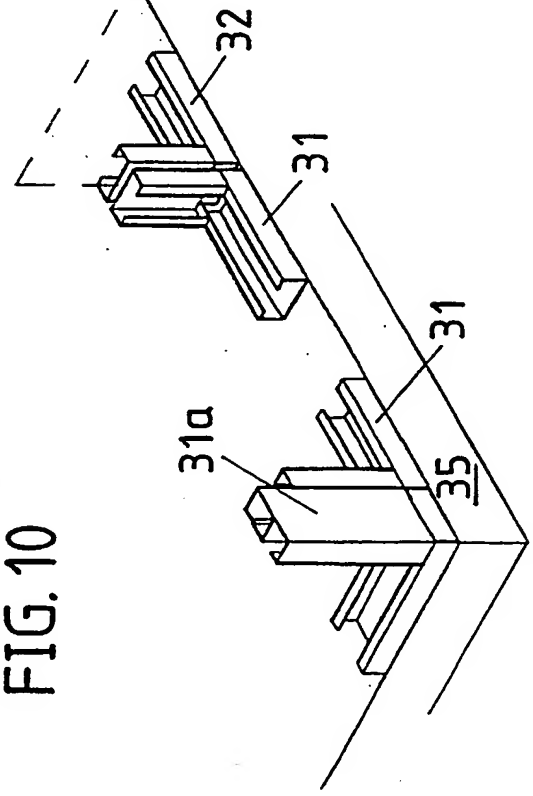


FIG. 9



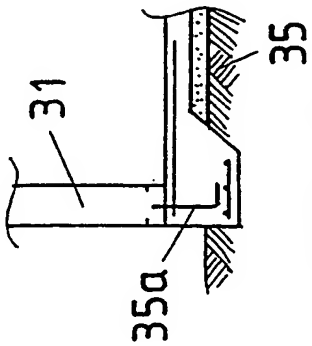
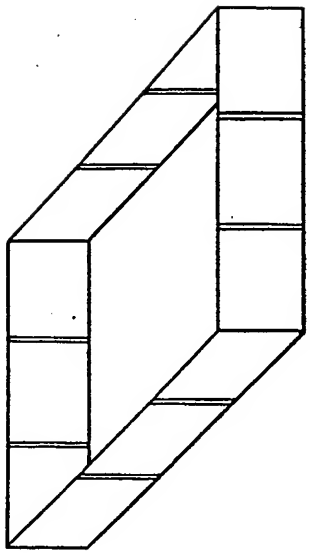
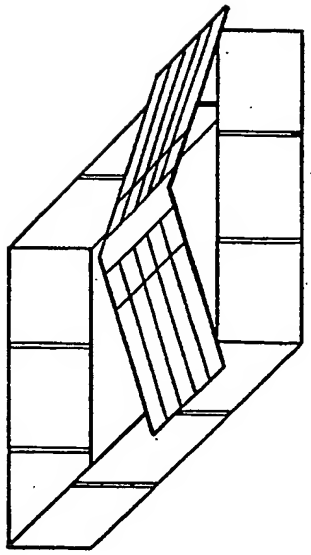


FIG. 10

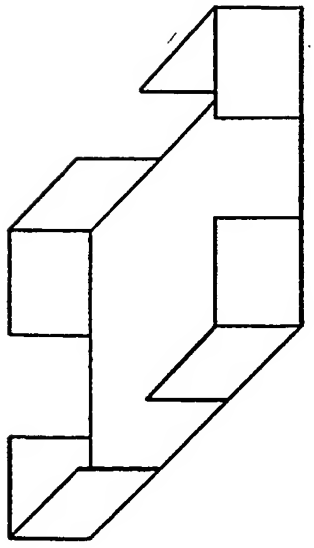


(b)

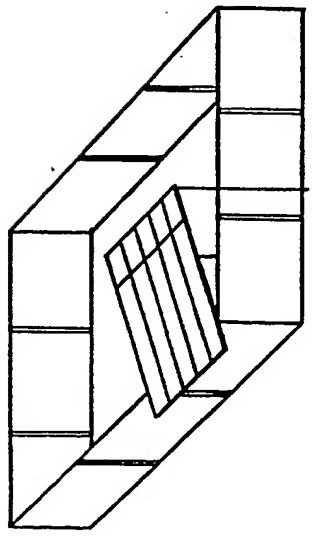


(d)

FIG. 11



(a)



(c)

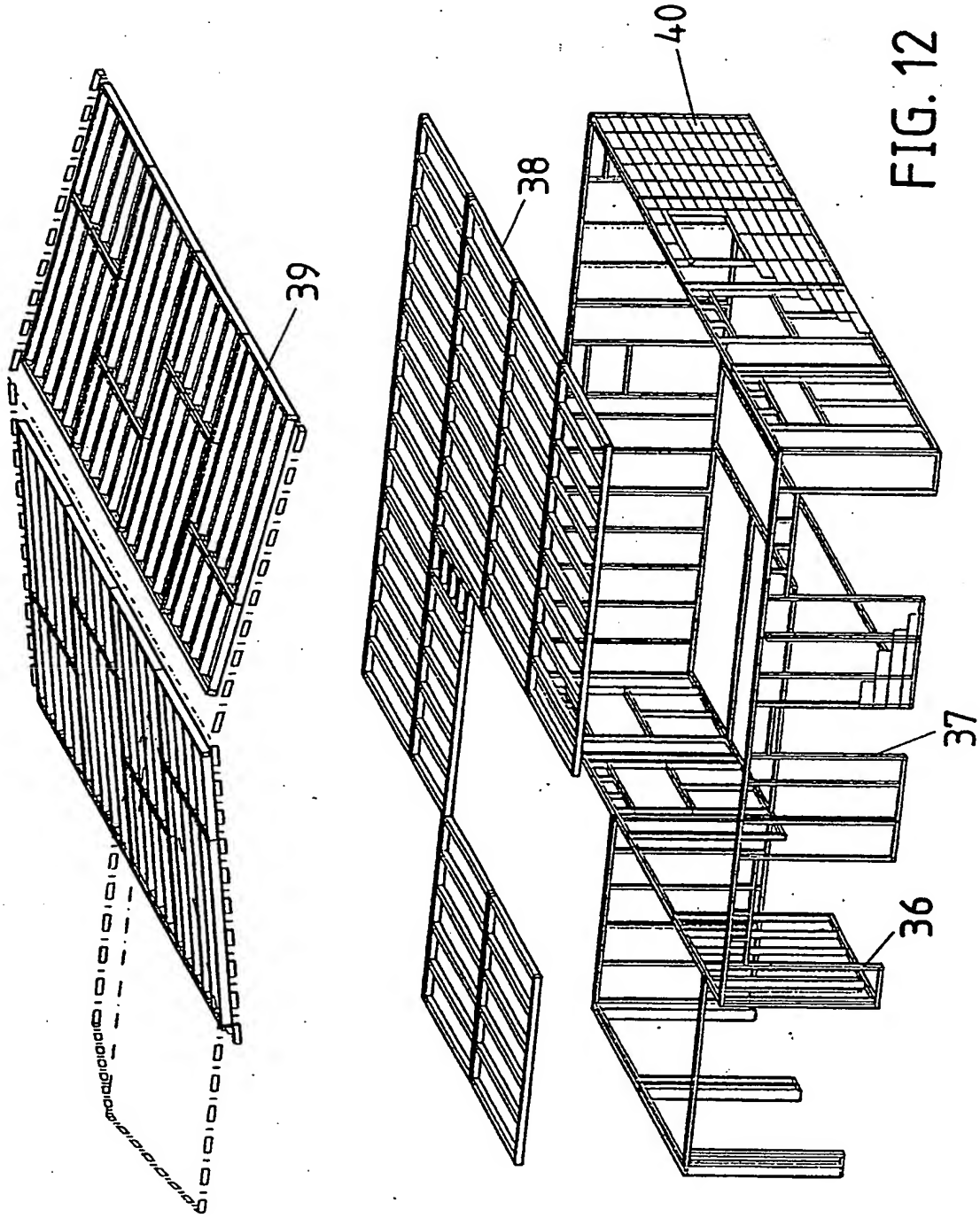


FIG. 12

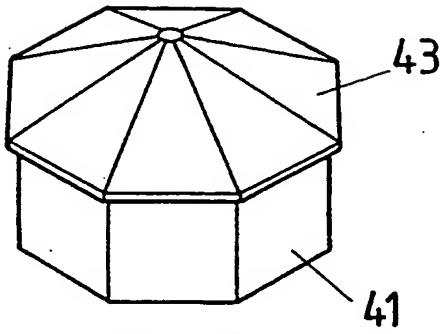


FIG. 13

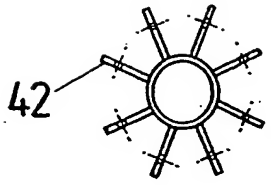


FIG. 14

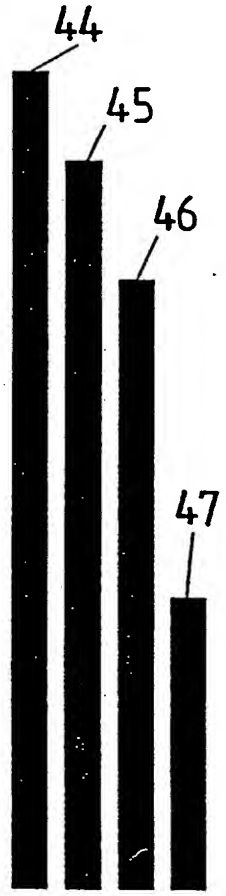
Strength Required	Material Combinations	Shed Size
30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 09 08 07 06 05 04 03 02 01		9m x 3.0m W50C 12m x 3.0m W41C 9m x 2.7m W50C 6m x 3.0m W55C 12m x 3.0m W41N 6m x 3.0m W41c 9m x 3.0m W41C 9m x 2.7m W41C 9m x 3.0m W41n 6m x 3.0m W41C 9m x 2.7m W41N 9m x 3.0m W33N 9m x 2.7m W33N 6m x 3.0m W41N 6m x 3.3m W33N

FIG. 15

INTERNATIONAL SEARCH REPORT

International Application No.
PCT/AU 96/00251

A. CLASSIFICATION OF SUBJECT MATTER

Int Cl[6]: E04B 1/343, 1/38, E04B 2/56, E04H 1/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC E04B 1/343, 1/38, E04B 2/56, 2/58, 2/70, E04H 1/00, 1/02, 1/12

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
DERWENT
JAPIO

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 95/0297 A (LEFTMINSTER PTY LTD) 19 January 1995 Page 6, line 9 - page9 line 35, Figures 1-6	1-21
X	AU 2286/61 A (SEKISUI KAGAKU KOGYO K.K.) 14 March 1963 Page 5 line 15 - page 6 line 23	1-4, 7-21
X	US 4858398 A (RICCHINI) 22 August 1989 Figures 7-8, column 5 line 54 - column 6 line 35	1-4, 7-21

[X] Further documents are listed in the continuation of Box C

[X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
1 July 1996

Date of mailing of the international search report
16 JUL 1996

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PCT/INTERNATIONAL SEARCH REPORT

International Application No.
PCT/AU 96/00251

C (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	AU 859/41 A (ZIPWOOD COMPANY LTD) 22 March 1941 Whole document	1-4, 7-14, 17-21
Y	US 4272930 A (FOSTER) 16 June 1981 Figures 1-8	1-21
Y	GB 2062044 A (HYGENA LTD) 20 May 1981 Page 2 Lines 16-106	1-21
Y	WO 94/29537 A (DE BLANKEN) 22 December 1994 Entire document	1-21
Y	US 3534515 A (BEED) 20 October 1970 Entire document	1-21
Y	FR 2638189 A (LEGRAND) 27 April 1990 Figures 1-19	1-21
Y	AU 2443/54 (167831) B (MAX BRAUN) 13 January 1955 Figures 1-19	1-21
A	GB 1536980 A (HORST KATHMANN) 29 December 1978 Figures 1-3	1-21
P,A	WO 95/13435 A (PANORAMA CONTRACT SERVICES (AUST) PTY LTD) 18 May 1995 Entire document	1-21

INTERNATIONAL SEARCH REPORT

International Application No.
PCT/AU 96/00251

Box 1 Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Independent Claim 1 is directed to a modular building wherein the roof sub-frames are connected to the wall sub-frames by first interconnecting plates and adjacent roof sub-frames are connected by second interconnecting plates at the ridges.

Independent claim 17 is directed to a method of constructing modular building wherein the roof sub-frames are connected to wall sub-frames by first interconnecting plates.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims
2. ☒ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

Supplemental Box
(To be used when the space in any of Boxes I to VIII is not sufficient)

Continuation of Box No: II

Independent claim 21 is directed to a method of extending a modular building wherein the sub-frames are disconnected from adjacent sub-frames and interconnecting plates, connecting additional sub-frames to existing frames, reconnecting disconnected sub-frames and attaching cladding to the complete extended modular building.

The matter common between these independent claims, ie attaching sub-frames using interconnecting plates is clearly disclosed by the following specifications:

- WO 95/02097 A (LEFTMINSTER PTY LTD) 19 January 1995
- AU 2286/61 A (SEKISUI KAGAKU KOGYO K.K.) 14 March 1963
- US 4858398 A (RICCHINI) 22 August 1989
- AU 859/41 A (ZIPWOOD COMPANY LTD) 22 March 1941

In light of this observation, the independent claims lack unity a posteriori.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No.
PCT/AU 96/00251

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
WO	95/02097	AU	69903/94	EP	710310	HU	9600051
		PL	312437	HU	9503619		
US	4858398						
US	4272930						
GB	2062044						
WO	94/29537	AU	69207/94				
GB	1536980	DE	2604320	FR	2340433	IL	51386
		IT	1082524	NL	7701130		
WO	95/13435	AU	81354/94				

END OF ANNEX